PHOTOGRAPHIC MANUALS, No. 1.

PLAIN DIRECTIONS

FOR OBTAINING

PHOTOGRAPHIC PICTURES

BY THE

CALOTYPE, ENERGIATYPE,

AND OTHER PROCESSES ON PAPER,

INCLUDING THE

CHRYSOTYPE, CYANOTYPE, CHROMOTYPE,

ETC., ETC.,

WITH ALL THE LATEST IMPROVEMENTS.

FOURTH EDITION WITH ADDITIONS.

PART I.

EDITED

BY JOHN H. CROUCHER.

LONDON:

T. & R. WILLATS,

OPTICIANS AND PHILOSOPHICAL INSTRUMENT MAKERS;

28, IRONMONGER LANE,

(LATE 98, CHEAPSIDE),

AND ALL BOOKSELLERS.

1851.

THE third edition of one thousand copies of this work having been exhausted, the Publishers venture to believe it so far fixed in public estimation as to render it advisable to print a new edition, in which—while all the really valuable portion of the old are retained, for the purpose of reference—much new matter has been added, and many errors have been corrected. The many useful improvements which have been introduced since this first work was issued, especially within the last twelve months, have obliged the Editor to add a second part, which will comprise the processes on paper and glass of M. Le Grey, and others, with a number of those in which the introduction of albumen, serum, &c. have tended to perfect the proofs on paper.

LONDON, *August*, 1851.

PLAIN DIRECTIONS

FOR

OBTAINING PHOTOGRAPHIC PICTURES BY THE CALOTYPE, ENERGIATYPE, AND OTHER PROCESSES ON PAPER.

THE art of Photography, or, as it is more appropriately designated, Heliography, by which, through the agency of light, the most accurate and beautiful representations of objects are obtained, is the fruit of modern science and research. The darkening of nitrate of silver under the rays of the sun had, indeed, been long known, but no attempt was made to apply this fact to the purposes of art, until 1802, when Mr. T. Wedgwood published a "Method of Copying Paintings upon Glass,* and making Profiles by the Agency of Light upon Nitrate of Silver." That eminent chemist, Sir Humphrey Davy, assisted Mr. Wedgwood in his enquiries; but being unable to discover any mode of fixing the images obtained, the experiments were abandoned. About 1814, Mr. Niepce, of Chalons sur Marne, turned his attention to this subject; and in 1827, presented to the Royal Society of London some specimens of pictures produced by the agency of light on glass, copper plated with silver, and highly planished tin; soon after which he entered into partnership with M. Daguerre. The latter gentleman, after repeated,

* We call especial attention to these facts at a time when there are many claimants to the merit of its introduction as a Heliographic medium.

but it would seem fruitless attempts to prepare a sensitive paper, entered upon those experiments which ended in the discovery of the beautiful process on silver plates which bears his name. In the interval, Mr. Henry Fox Talbot made known the results of his enquiries into the action of light upon salts of silver, in a paper read before the Royal Society in January, 1839, which he followed up in the succeeding month by another, detailing his method of preparing a paper for photographic purposes, and the fixing the designs. This paper was not, however, sufficiently sensitive to be used in the camera-obscura; but Mr. Talbot continuing his experiments, found means to increase the sensibility of his paper, and in 1841 patented the process, to which he has given the name of CALOTYPE, but which has recently (in accordance with the fashionable photographic nomenclature) been termed the TALBOTYPE. Many distinguished scientific men have lately devoted their attention to this subject; and various processes on paper have been from time to time announced by—Sir John Herschel, Mr. Robert Hunt, and others, under the names of AMPHITYPE, ANTHOTYPE, CHROMOTYPE, CHRYSOTYPE, CYANOTYPE, ENERGIATYPE, etc., etc. The Daguerreotype, from its peculiarity and importance, demands a separate consideration, and is made the subject of a distinct number of the present series.* Avoiding, as far as possible, all scientific technicalities, we shall endeavour to give such concise and plain directions as will enable the amateur to obtain the most successful results. Those who may desire to learn something of the philosophical principles involved in the experiments brought under their notice in the subsequent pages, will do well to consult Mr. Robert Hunt's valuable work, entitled "Researches on Light," published in the course of 1844.

Before entering on the various processes we are about to describe we shall briefly notice the apparatus which the amateur will require, in performing this class of photographic operations. Where camera pictures are not desired, it will be simple and inexpensive.

Some camel's-hair brushes, a quire or two of good paper and a few sheets of wove blotting-paper, are indispensable. The brushes should be large, the hair collected together in one pencil, and they must never be bound in tin. A separate brush is required for each solution, which should be thoroughly washed after using.

* Scientific Manuals, No. 2. Third Edition. Practical Hints on the Daguerreotype. T. & R. Willats, 28, Ironmonger Lane, Cheapside, London.

Very durable brushes are made of finely spun glass and very economical ones may be made by taking a plug of cotton wool, attaching it to a piece of silver wire, bent at the ends, and so drawing it into the end of a glass tube. The cotton may be afterwards trimmed round with a pair of scissors.

The paper should be carefully selected: to a want of sufficient caution in this respect, must be attributed the constant failures of many experimenters. Whatman's or Turner's superfine yellow wove is generally recommended; we have lately met with some very excellent paper, which can be had at the publishers. Every sheet should be examined by a strong light, and all those rejected which have any spot upon them, as also those which are found on trial to imbibe the solutions unequally. One side of the sheet should have a pencil mark upon it, by which it may be recognised. The blotting-paper must be white wove, and the sheets used in different stages of the process should be kept separate. A flat trough of porcelain ware, which is not acted upon by chemical preparations, and a slab of the same material or glass, are also required for preparing and washing paper.

Copying Frame.

All that is absolutely essential for this purpose, is a piece of plate glass of a sufficient size, and a board of similar dimensions covered with soft flannel; these, with the prepared paper and object to be copied placed between them, may be kept in contact by three or four binding screws. But the more convenient apparatus is represented at fig 1. consisting of a frame in which a piece of plate glass (a) is fixed, with a wooden back covered with a flat cushion of flannel. The back may be removed to admit of the introduction of the paper and object, and when replaced, may be pressed evenly and firmly against the glass by screws

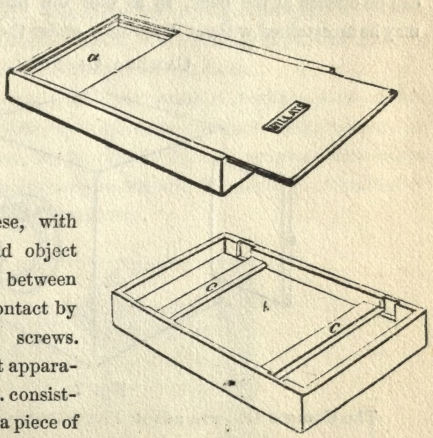


Fig. 1.

(*cc*) placed at the back. A sliding-top covering the glass excludes the light, until it is desired to submit the paper to the action of light, or to protect it from change if kept for a short period without setting.

THE IMPROVED PRESSURE FRAME (FIG. 2.).

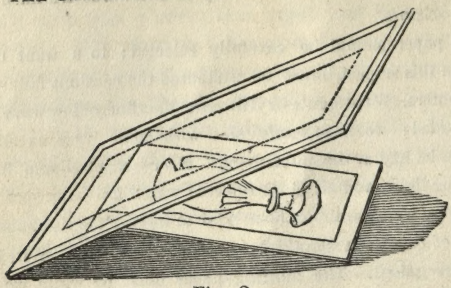


Fig. 2.

This is a more perfect form of apparatus than that just described; a door at the back admits the prepared paper and the object to be printed, while close contact is secured by clamps at the back, which press down the paper firmly and evenly. By a simple arrangement, it can be opened at the back, so as that the progress of the impression may be ascertained without disturbing either the paper or the copy.

CAMERA OBSCURA.

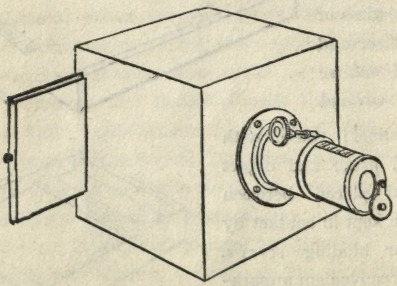
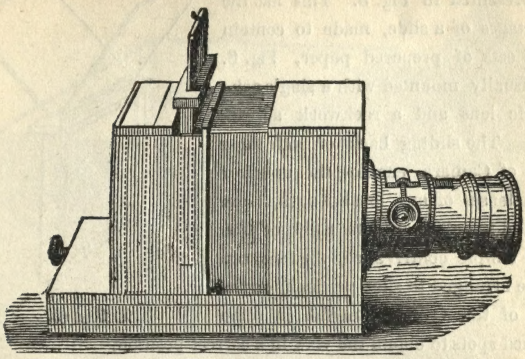


Fig. 3.

The Camera Obscura adapted for photographic purposes, is a very superior instrument to that commonly sold under the name. The lens may be either achromatic or miniscus. Fig. 3 is the most simple arrangement and made of various dimensions, usually to take a picture 3 inches square.

WILLATS'S IMPOVED CAMERA, WITH ACHROMATIC COMBINATION LENSES, (Fig. 4.)



Which may be used for any photographic purpose, is a box, the front of which is mounted with a double combination lense. The back part of the camera slides into the front, and to secure a very accurate adjustment, is mounted with a screw. It is moved in or out by turning a small handle at the back. The frame with the ground glass is furnished with a moveable top and sides, which, when extended, exclude the light, and aid the operator, in determining the best focus.

The second frame consists of a box, made to receive a piece of slate, or glass, which is held tight by a spring at the back: this frame is furnished with a sliding door, laying over the top of the camera when raised. A picture four-inches square may be taken in this camera. This Camera and lens is best adapted for portraiture.

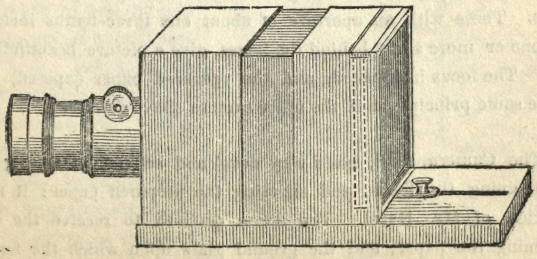


Fig. 5.

But a Camera, more especially adapted for views, simpler and stronger, is represented in Fig. 5. This has the advantages of a slide, made to contain two sheets of prepared paper, Fig. 6. It is usually mounted with a single achromatic lens and a rackwork adjustment. The sliding back of both these forms of Camera, enables the operator to use lenses of any focal length, from four and a half inches to eight or ten. By a simple contrivance, the lens can also be arranged to slide vertically on the front of the Camera, useful in some confined spots to obtain the view in a correct position.

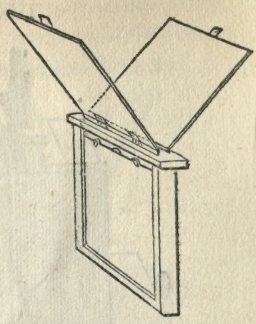


Fig. 6.

The Camera, fig 7, is constructed on a plan recommended by Mr. Cundell. A single miniscus lens may be used, or two miniscus lenses, each about 3 inches in diameter, and twenty-four inches in focus, are mounted in a sliding tube, their conjugate foci being as that of a single lens of thirteen inches. These with an aperture of about one three-tenths inch, and with one or more stops behind the lenses, give a picture beautifully defined. The focus is adjusted, and the prepared paper exposed, much on the same principle as in the other camera above described.

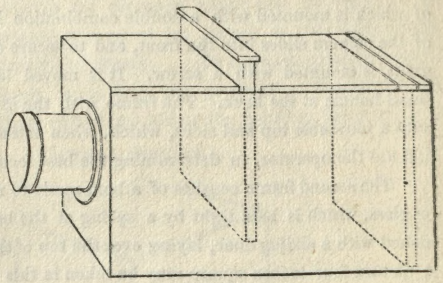


Fig 7.

The Camera, fig 8, has a very novel and convenient arrangement for obtaining the focus, and exposing the prepared paper: it is the invention of Mr. Hazel. The frame destined to receive the slider containing the paper, and the ground glass upon which the focus is obtained, are arranged at right angles to each other and turn upon a

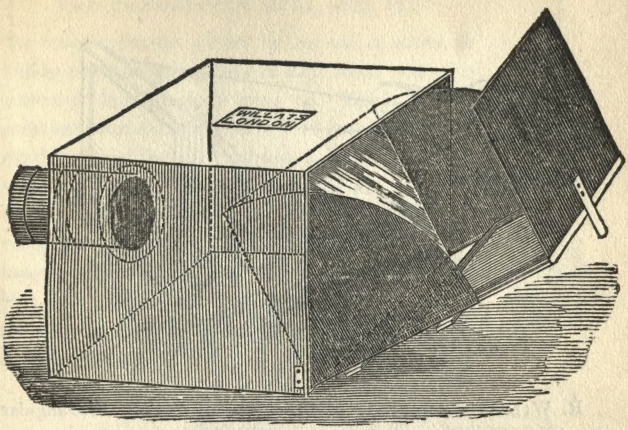


Fig. 8.

joint, at the lower edge of the back part of the Camera. The focus being obtained, the slider with the prepared paper is introduced into the frame, when, by turning it upwards, the ground glass falls to the bottom o the camera, while the slider exactly occupies its place. By an ingenious arrangement, a short lever connected with the slider, at the same moment raises the shutter which secures the paper from the light.

The Camera represented, (Fig. 9,) is a new and very useful article, being made to fold up into the compass of a moderate sized book, and may be carried in the pocket without inconvenience. It is so arranged as to put together with the utmost ease, and is kept securely in its place by screws in the sides and back. This form of Camera is, from its portability well adapted for Tourists.

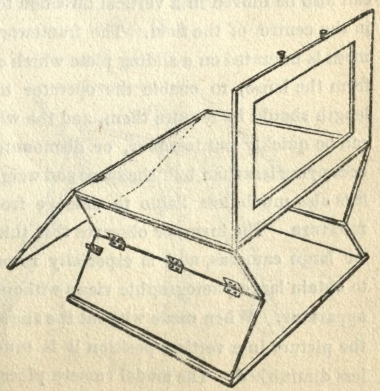


Fig. 9.

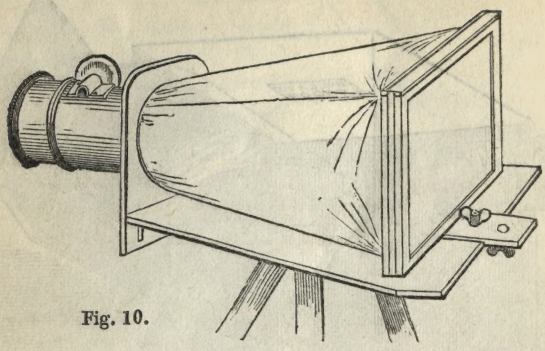


Fig. 10.

R. WILLAT'S Improved Portable expanding Camera, with angular, vertical, and horizontal adjustments as shown at the Great Exhibition of the Works of Industry of all Nations, 1851.

A camera, which combines every advantage with extreme portability, invented by Mr. RICHARD WILLATS.

The novelty of this arrangement consists in the expanding cloth body and the simple method by which the paper or plate used can be placed at any angle that may be found best for obtaining a good general focus. The lenses have a fine rackwork adjustment for correcting the focus, and can also be moved in a vertical direction to bring the object to be copied in the centre of the field. The framework at the back of the instrument is mounted on a sliding plate which can be clamped at any distance from the lense, to enable the operator to use lenses of different focal length should he require them, and the whole camera so arranged that it can be quickly put together, or dismounted and packed for travelling, occupying less than half the space and weight of the old forms of Camera; it is also much less liable to damage from extremely hot climates or moisture. The inventor observes that this arrangement is best adapted for large cameras, and is especially recommended to travellers wishing to obtain large photographic views without the encumberance of a bulky apparatus. When made without the angular adjustment simply to take the picture in a vertical position it is much less in cost, and the bulk is less diminished. The model camera placed in the Exhibition will take a photograph 10¼ inches by 8½ inches.

The Photographic Etna, (Fig. 11.)

For bringing out the picture by the aid of steam, is highly useful, as the picture is kept moist while the process of development is going on. This is a very great improvement on the tin bottle formerly used, the rapid drying of the paper causing great discoloration and want of uniformity in the development of the image. The old form with a slate side, may however be procured by those who prefer its use. Fig. 12.

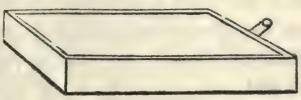


Fig. 12.

Fig. 11.

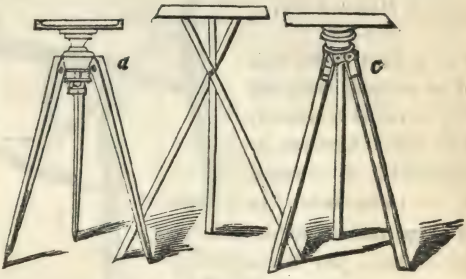


Fig. 13.

Fig. 14.

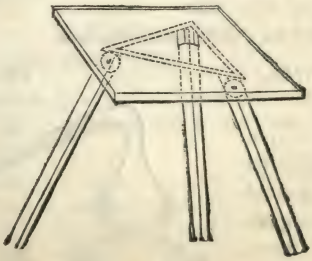


Fig. 15.

The Tripod Staff, (Figures 13 to 15).

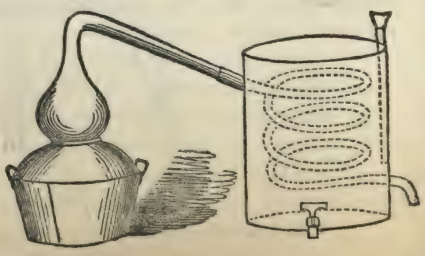
Upon which the camera may be rested, when no other suitable place can be found, is a very necessary auxiliary in taking views. It is about four feet six inches high, and carries a small table on which the camera is placed. There are several varieties, differing in their construction and price. A simple and portable form shown fig. 14. is an excellent cheap stand for travellers.

Fig. 16.

THE HEAD REST,
Fig. 16.

May be fixed to the back of an ordinary chair, and may be raised or lowered, and moved forwards or backwards, at pleasure. It is indispensable in taking portraits. The Publishers have just introduced a more highly finished support for the head, invented by Mr. Johnstone, suited for Public Establishments.

FIG. 17.



THE STILL,
Fig. 17,

Is used for procuring distilled water which is required in some quantity for the Photographic process. It consists of a united iron body,

with a neck which can be connected with a worm in another vessel. The water is introduced into the body through a small opening, afterwards stopped with a cork, and the vessel is placed upon an ordinary fire, the other vessel being filled with cold water, renewed from time to time; the vapour passes through the worm and is conveyed by a pipe into a bottle prepared to receive it. An alembic, or a glass retort connected with a condenser, will answer the same purpose and may be used over the flame of a lamp or gas light, and, where small quantities of water are required (absolutely pure), is the best form of apparatus.

Chemicals.

These should be all of the best quality, and should only be purchased of respectable parties who will guarantee their purity. Cheap chemicals are seldom economical, as the adulteration of any of them will interfere most annoyingly with the successful prosecution of the experiment. The following list comprises almost every article required in the processes hereafter described:—

Nitrate Silver in Crystals*	Proto-sulphate Iron
Iodide Potassium	Ammonia-citrate Iron
Bromide Potassium	Ferro-sesquicyanuret Potassium
Cyanide Potassium	Yellow-Ferro-cyanate of Potash
Fluoride Potassium	By-chromate Potash
Hyposulphite Soda	Sulphate Copper
Pure Gallic Acid	Glacial Acetic Acid
„ Succinic Acid	Strong Ammonia

* The Nitrate of Silver in solution is very easily affected by light, and should be kept in a dark place.

THE CALOTYPE.

The Calotype, or Talbotype, is, as we have already mentioned, the invention of Mr. Fox Talbot, or is claimed by him.† It has been much im-

† So early as April, 1839, the Rev. J. B. Reade made a sensitive paper, by using an infusion of galls after nitrate silver. By this process Mr. Reade obtained several drawings of microscopic objects, by means of the solar microscope. The drawings were taken before the paper was dry. In a communication to Mr. Brayley, Mr. Reade proposed the use of gallate or tannate of silver; and Mr. Brayley, in his public lectures in April and May, explained the process, and exhibited the chemical combination which Mr. Reade proposed to use.

proved since its first introduction. To Mr. Cundell in particular we are indebted for many practical suggestions, which he first communicated to the world in the 'Philosophical Magazine,'‡ and the more recent experience of other photographers has produced valuable modifications of the original process. Giving such simple directions for conducting it as we have found the most likely to produce satisfactory results, we shall include such variations as seem worthy the attention of the amateur.

Preparation of the Iodized Paper.

Having selected paper of a close and even texture, and fine surface, such as that recommended p. 4, and marked it on one side with pencil, wash this side over carefully with a solution, consisting of 30 grains nitrate silver, dissolved in one ounce distilled water, which apply plentifully with a brush, thoroughly wetting every part, but leaving no moisture unabsorbed; this should be done on a hard smooth board, and thoroughly dried in the dark. Then take a solution of two hundred grains of iodide potassium in half-a-pint of water, to which fifty grains of salt have been added; draw the paper over the surface of the liquid, letting it repose upon it, when plastic, for a few seconds, never more than one minute. After dipping, drain it, and lay it flat until about half dry, then set it afloat in clean water for ten minutes, drawing it now and then along the surface: hang it in the air to dry, and when dry smooth it by pressure. It is of the utmost importance that all the soluble salts should be got out of the paper, and this is readily effected by leaving it floating for a time in water: a rougher washing would loosen the iodide of silver. This paper will keep some time if carefully laid by in a portfolio.

Application of the Gallo-Nitrate of Silver.

Dissolve fifty grains nitrate silver in two ounces of distilled water, to which add one-fifth of its volume of glacial acetic acid. Dissolve also a small quantity crystallized *gallic acid* in distilled water, about eight grains to the ounce.* When about to use, mix one part of the latter

‡ No. 169, May, 1844.

* A small quantity only of the gallic acid solution should be made at once, as it soon undergoes a change, becoming of a strong yellow colour, and unfit for use. Pyro-Gallic Acid has been recommended to replace the ordinary Gallic Acid. It is prepared by making a decoction of gall nuts, evaporating them to dryness, putting the dry extract into an iron vessel, with a head, exposed to a high temperature. The fumes collected in the head, form the Pyro-Gallic acid.

solution with two parts of the former, mixing however only a sufficient quantity for immediate use, as the resulting liquid decomposes very rapidly. This, and all the operations connected with the Calotype, should be conducted in a room from which daylight is entirely excluded: it is, indeed, preferable to surround any artificial light, which may be used, with a screen of yellow glass, gauze, or paper, the rays which pass through materials of this colour having little or no influence on the most sensitive preparations. The iodized paper may now be washed evenly over on the prepared side, which may be recognised by its pale yellow colour, with the gallo-nitrate mixture, and must then be immediately transferred to clean blotting-paper, and all the moisture carefully removed from the surface. A more even distribution of the gallo-nitrate solution may, perhaps, be obtained by pouring a little out on a slab, and passing the iodized paper over it, taking care that contact in every part is secured, and blotting as before. To save time, the gallic acid may be applied previously, and the paper kept thus, half prepared.

Great care should be exercised that the Gallic Acid does not touch the back of the picture, this may be prevented by turning up the edges of the paper all round before applying it.

Placing in the Camera.

Having prepared iodized paper as directed above, in which state it is called calotype paper, it should be quickly transferred to the camera frame, enclosed between a plate of slate or iron, and a piece of plate glass to keep it smooth. If the slate or iron be gently warmed, the sensibility of the paper will be increased. The camera must now be put in the proper position, directed towards the object to be copied, and a good clear picture obtained on the ground glass. This picture, when an achromatic glass is used, will give a good working focus, but when the camera is fitted with a miniscus, or any other kind of non-acromatic lens, a peculiar adjustment is necessary to obtain what is called the chemical focus, which differs materially from the optical or visible focus. This chemical focus is about one thirty-sixth part shorter than the other, but the scale should be adjusted according to the lens and camera used.

The wood cut in the margin (Fig. 18) gives a scale of relative differences adapted to a combination of miniscus lenses, described by Mr. Cundell, O F being the optical focus, and C F the chemical focus. This scale can be inserted into the top of the camera, so that the optical focus having been obtained the sliding back may be shifted to the division in the chemical focus marked with the same degree.

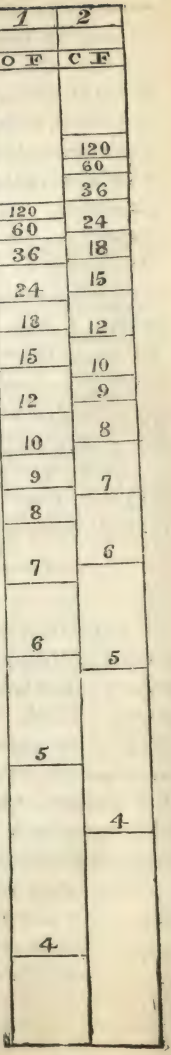


Fig. 18.

The frame, with the prepared paper, the shutter being perfectly closed is now placed in the camera. The time of exposure here depends upon so many circumstances,—the strength of the light, the colour of the object, the description of lens used in the camera, etc., etc., that it is impossible to give any practical rules upon the subject,—experience will be the best instructor. With a single achromatic lens in the morning sunshine, from forty to sixty seconds is perhaps requisite for a building and from one to three minutes for a portrait: in the shade, from two to three minutes are required for either. Pictures are taken in a much shorter time, in from ten to twenty seconds, by using a combination of lenses, or with a single lens, under very favourable circumstances. The best position for taking a building, is a distance about twice the measure of its greatest dimension, and from an elevation of about one-third of its height. Where some parts of the building are nearer than others, place the focus to that part which it is most desirable to have clear, and neglect the others. It is not advisable to take new and old buildings in the same picture, as the time necessary for the old will over-do the new. The sky is frequently overdone, which may be prevented by interposing a black screen upon the glass over that part which corresponds to it, and which may be previously ascertained by reference to the ground-glass.

Portraits should be taken in the open air, but not in the sun. The best uniform back-ground is a blanket, but figures may be grouped in front of a house, or mass of foliage. There should not be too much white in the dress, as it will be solarized or blotched, before the other parts are distinctly pourtrayed. More particular directions for obtaining artistical portraits will be found in No. 2 of the present series. It has been recently proposed to whiten the inside of the Camera and the interior of the tube of the lens as a means of accelerating the production of the image. Mr. Claudet has shewn this idea to be erroneous, as although the time of exposure may be a little shortened, the picture is much injured in force and clearness.

Bringing Out the Impression.

When the paper is removed from the frame, always in the dark, nothing is visible; it must then be again washed over with the gallo-nitrate of silver, and exposed to a radiated heat from a gentle fire or a bottle of hot water, or to what is still better a jet of steam, holding the paper over it, never suffering the paper to become in any part perfectly dry.* When the picture is, in the opinion of the operator, sufficiently distinct, it must be carefully washed in distilled or rain water, as warm as the finger can bear—the water being changed once or twice, and then dried in blotting-paper.

Fixing Process.

To fix the picture, soak it for two or three minutes, or longer if strongly developed, in a solution of half an ounce of hyposulphite soda to a pint of water, turning it occasionally, and then soak it in water from twelve to twenty-four hours, according to the thickness of the paper, and dry it. The sweetness of the hyposulphite of silver, which is readily communicated to any quantity of water, affords an excellent means of testing when the picture is freed from its influence. It should be washed until the water is perfectly tasteless.

The Calotype process is intended solely for the camera-obscura, and the pictures so obtained are all negative; that is, the lights and shadows are reversed. From these, however, any number of positive pictures, or

*A convenient apparatus for this purpose is described page 11, and may be had of Messrs T. & R. Willats.

pictures in which the lights are represented by lights, and the shades by shades, may be taken in the manner described under the next head.

Mr. Fox Talbot has published a method of removing the yellowish tint from pictures taken on calotype and other photographic papers prepared by nitrate of silver, by plunging the picture into a bath composed of hyposulphite of soda, dissolved in ten times its weight of water, and heated nearly to the boling point. The picture should remain in it about ten minutes, and be then washed in warm water and dried. By this means, he says, the picture is rendered more permanent, and the lights whiter. He also recommends the following means for improving photographic pictures:—

"A copy or reversed impression of a photographic picture is taken in the ordinary manner, except that it remains in the light twice the usual time; its shadows are thus rendered too black, and its lights not sufficiently white. It is then washed and plunged into a bath of iodide of potassium (of the strength of five hundred grains to each pint of water) for one or two minutes, which makes the picture brighter, and its lights assume a pale yellow tint. After this it is washed, and immersed in a hot bath of hyposulphite of soda, until the pale yellow tint is removed, and the lights remain quite white. The pictures, thus finished, have a pleasing and peculiar effects of light and shade, which is not easily attainable by other means."

The transparency of calotype and other pictures may be increased by causing melted wax to penetrate the pores of the paper in the following manner. A small quantity of white wax is scraped on the back of the picture; it is then placed between two other papers, and a hot iron passed over it, which melts and spreads the wax. Or a little boiled oil may be spread over it, and the excess removed by bibulous paper. Canada balsam, or mastic varnish, with turpentine, are very good materials for the same purpose.

It may be necessary to remind the reader that the CALOTYPE is a patented process. The Patent was taken out Jan 14th, 1841. In the two patents obtained by Mr. Fox Talbot, the use of the following processes is claimed as his exclusive right.

The employment of gallic acid, or tincture of galls, in conjunction with solutions of silver, to render prepared paper more perfect. The obtaining portraits from life by photographic means upon paper. The

employing Bromides for fixing the image obtained. The transferring pictures from one sort of sensitive paper to another. The employment of boiling solutions of hyposulphites, to give increased whiteness to calotype and other photographic pictures; and the process of waxing, when the picture has been rendered more transparent by these means. The process of warming the paper, during the formation of the image, by placing a warm plate of iron behind it to increase the sensibility. The employment of iodized paper excited or rendered sensitive by a liquid, containing only a small portion of nitrate of silver, and subsequently dried, so as to preserve its sensitive state. The varying lights and shadows of a picture by iodide of potassium, and the fixing the picture so changed. The placing a sheet of white or coloured paper behind photographic pictures, after having waxed them. The obtaining enlarged portraits and pictures by throwing a magnified image thereof, by lenses, on photographic paper, The application of photography to printing, by arranging suitable letters or figures, so as to form pages, and making photographic images thereof. The system or combination of the following several photographic processes into one, whereby permanent and perfect copies of the positive kind are obtained, namely, the formation of the negative copy—the fixing it, so that it shall have the requisite transparency, and endure great subsequent exposure to the light—the formation of the positive from the negative copy, and its permanent fixation.

The subjoined modification of the Calotype process has been kindly furnished by a very successful practitioner :—

1. Wash the paper with a brush filled with a solution of nitrate silver three grains, distilled water one ounce.

2. When it is half dry, draw it over the following solution, letting it float on the surface for about half a minute :—Iodide of potassium 200 grains, salt 500 grains, water half-a-pint; then withdraw it and set it afloat in pure water for ten minutes; dry and preserve in a portfolio.

3. When you wish to use the paper, prepare three solutions: No. 1, Nitrate silver 50 grs.; acetic acid two drachms; water one ounce. No. 2, A saturated solution of gallic acid. No. 3, 15 drops of No. 1; 15 drops of No. 2; water 60 drops. Cover the face of the paper with No. 3 solution, by means of a very soft brush; taking up the excess of liquid with

blotting-paper; put it into the camera, and expose it for a time, depending on the strength of the light.

4. After taking it from the camera, brush it quickly over with the same solution No. 3, then expose to heat until the paper is sufficiently developed. If the paper is not to be used immediately, wash it the first time with a mixture containing 30 drops of solution No. 1, 30 drops of solution No. 2, 90 drops water; and develop with No. 3.

5. Well wash the picture and pass between blotting-paper, then into a bath of hyposulphite. Wash it afresh in plenty of water and dry.

Mr. Brodie, whose specimens of Photography upon paper are so beautiful, has kindly communicated the following modification of the Calotype process which he has adopted.

A good paper (Mr. B. prefers Nash's) is marked, the marked side passed over a solution of ten to fifteen grains nitrate silver in one ounce distilled water, every part touching the solution, and is dried gently by the fire. It is then immersed in a bath of iodide potassium, fifteen grains to the ounce of water, dried, and afterwards soaked in plenty of water for twelve or fifteen hours. Before placing in the camera, it is washed over with a solution containing nitrate of silver and acetic acid in the proportion of about one-tenth of that used in Mr. Talbot's formula, gallic acid being omitted. When removed from the camera, the picture is brought out by dilute gallic acid without heat. When sufficiently developed immerse in water ten or fifteen minutes, then apply the hyposulphite soda, of the strength of one ounce in a pint and a half water, and wash carefully, as before directed.

Papers that have undergone repeated washings are liable to become rough and to have the pile raised. Mr. Brodie recommends that such proofs should be placed between two or three sheets of highly glazed paper, and rubbed well over with a smooth ivory paper knife, by which means the paper will again acquire a fine surface. The same gentleman has suggested a very elegant method of producing the appearance of sky on a positive picture, which is often wanting from that part of the negative having become entirely and equally darkened. By laying a piece of black paper over the picture when taken from the printing frame and gradually moving it downwards from the top, a nice graduation of tone is produced, which gives a fine effect to the picture.

The following elegant mode of preparing iodized paper by one wash, was originally introduced by Dr. Lyon Playfair.

Precipitate iodide of silver, from a solution of nitrate silver, by iodide of potassium. Of this precipitate, collected on filtering paper until nearly dry, take 3 grains and add it to 1 oz. distilled water; to this add iodide potassium until the precipitate is re-dissolved, it will take about 30 grains. Filter the resultant liquid and keep carefully. Wash the paper over with the liquid, dry in the dark, and preserve for use. When required in the Camera set the paper afloat in a vessel of water, the prepared side downwards, let it remain 15 or 20 minutes, or longer if the paper has been made any length of time, and dry off with blotting-paper. It is then ready to be rendered sensitive by the aceto-nitrate solution in the usual manner.

The following observations on the Calotype process were kindly furnished to us by the late Mr. Hazel.

Good Calotype paper may be prepared by either of the foregoing processes, but the novice often complains of the tediousness of the formulæ, and of uncertainty in effect. The following hints and modifications may not be undeserving of notice.

Provide a piece of deal board, of the width of the paper to be prepared, and six or eight feet in length. Pin the paper to this board with bone pins to its entire length, letting the edge of each piece underlap the foregoing one about one-eighth of an inch. Place the board in an inclined position, and with a flat, soft, broad brush, lay on the first solution of nitrate of silver, beginning at the top and proceeding carefully and lightly downwards, taking all precaution that the entire surface of the paper be evenly and thoroughly covered. Now incline the board with its edge downwards that the superfluous moisture may run off, and so leave the paper to drain and dry. As soon as it is quite dry lay on the solution of iodide of potash in the same manner; when the paper is again about half dry, it must be taken off the board and dipped into or floated on water, taking care that no air bubbles intervene between the prepared side of the paper and the water. It may remain in the water for any period varying from five minutes to five hours; the only difference is that if it remains but the shorter period, it will be rather more sensitive, but will not keep so long uninjured. After this soaking, the paper should be fastened with a pin by one corner to some projecting wood or shelf, and suffered to drain dry, and then put away for use.

The whole of this process should be conducted in a *dark, cool room. The flame of the candle or lamp must be covered with a yellow glass*

shade, for if white light be used, or if the paper be dried by the fire, the operator will be mortified to find in the end a stained photograph, which he will be at a loss to account for. Neither in this way or in any subsequent part of the proceeding should the paper be touched, either by *wiping*, or *with blotting-paper*, for such would disturb the surface and leave false markings which will afterwards appear.

Before placing in the camera it is more economical, as well as convenient, to use the solution of nitrate of silver in the first place only, and reserve the gallic acid for bringing out the impression. The gallic acid solution should, when used, be mixed with one-half gum water, which will prevent its sinking so deeply into the paper, and allow it to wash off freer. A satured solution of sulphate of iron employed the same way will bring out the impression equally well with that of gallic acid, with this advantage that the picture fixes with rather more certainty.

Paper photographs possess the advantage of being cheaply procured and of giving any number of copies without the aid of the engraver; but are not equal in sharpness and beauty of delineation to the impressions received by the metallic of plates of the Daguerreotype. Operators are well aware that the calotype suffers considerably after it is taken from the camera by the subsequent processes of washing, fixing, and transferring, and perhaps the inferiority will remain until some more suitable material can be found whereon to receive the negative picture. The surfaces of ivory, horn, skin, and Indian rubber, become with the same preparation equally sensitive with paper. Thin horn, such as is used by the lanthorn makers, is an admirable substance whereon to impress the negative picture, and very superior specimens have been procured upon it. The finest lines were not in the least disturbed by washing or rubbing, and from its semi-transparency it promised to yield equally good positive pictures; but there is a difficulty of obtaining it sufficiently free from veins and spots. Whenever horn is used, it must be placed in the camera between two pieces of plate-glass, otherwise it will warp in drying.

Mr. Hazel was engaged in researches on the application of photography to glass, and had already produced some promising specimens, when his death occurred.

We have preferred placing some new and valuable applications of the Calotype process in the appendix, rather than disturb the order to which our readers are accustomed.

Positive Pictures.

Many attempts have been made to produce positive calotype pictures by a single process, but the methods proposed are all difficult of execution, and rarely successful.

Mr. Hunt has reccommended the following process as giving very satisfactory results in copying engravings, leaves, etc., though it is hardly sensitive enough for the camera. We have somewhat abridged Mr. H.'s directions.

Good letter paper is soaked for five or ten minutes in a solution of forty grains muriate of ammonia, or muriate of baryta, in four ounces water. Each sheet is carefully removed from the fluid, placed on a glass or porcelain slab, wiped over with a very clean linen rag. and then hung up to dry. When dry, the paper, pinned by its four corners to a board, is washed with the following solution:—One hundred and twenty grains crystallised nitrate silver are dissolved is twelve fluid drachms distilled water and four fluid drachms alcohol added to it. This renders the solution opaque, but after a few hours it grows clear, and a minute quantity of a black precipitate falls, which must be separated by filtering through white blotting-paper. This solution is applied with a very soft sponge-brush over one surface, care being taken that the fluid is equally diffused over every part of the paper, and that this is done without applying the bush a second time to any portion of the surface. The wet paper is now exposed, without delay, to bright sunshine,—the paper should only be prepared on bright days,—when the solar rays instantly darken the paper. The darkening often proceeds unequally at first, but a second application of the nitrate of silver, before the paper becomes hard and a renewed exposure to sunshine will remedy this defect. The paper has now an uniform surface of a fine chocolate brown colour. It is now to be dried quickly in the dark, and preserved for use between blotting-paper.

The bleaching fluid is made as follows:—Thirty grains iodide of baryta are dissolved in an ounce of water; to this is added a single drop of sulphuric acid, by which some baryta is separated as a sulphate, and some free hydriodic acid is liberated and remains in the fluid. To use the paper in the camera, wash it over with this solution, and place the paper, carefully spread on a glass plate, wet in the camera. It is important that the wet paper should not be placed upon wood or any carbonaceous body, as in that case a peculiar blackening, instead of bleaching will take place. Paper thus prepared is not very sensitive, and ex-

posure of from twenty minutes to half an hour will be required. The results, however, are very beautiful. To copy engravings, the print must first be soaked in water, by which it is rendered transparent and protected from injury by the chemicals in the photographic paper. It is then laid out smoothly upon the glass of the copying-frame and the dark surface of the hydriodated paper pressed very closely against the face of the picture. Thus arranged, it is exposed to good sunshine, and allowed to remain until the uncovered portion of the paper, which rapidly bleaches, begins again to turn brown. The paper being removed, is placed in clean water, to disolve the hydriodate, after which the picture is rendered permanent by fixing with hyposulphate soda. Botanical specimens, etc., are treated in a similar manner.

The following plan was introduced by Professor Grove, at the meeting of the British Association held at York. The above paper, or ordinary calotype paper, is darkened until it assumes a deep brown colour, almost amounting to black; it is then re-dipped into the ordinary solution of iodide of potassium and dried. When required for use, it is drawn over diluted nitric acid, one part acid to two and-a half parts water. In this state, those parts exposed to the light are rapidly bleached, while the parts not exposed remain unchanged. It is fixed in the usual method. Mr. Grove brought forward, on the same occasion, another process, by which a negative calotype was converted into a positive one. An ordinary calotype picture is to be taken in the camera and developed by gallic acid, then drawn over iodide of potassium, and dilute nitric acid, and exposed to full sunshine: while bleaching the dark parts, the light is re-darkening the newly precipitated iodide in the lighter portions, and thus the negative picture is converted into a positive one.*

These processes are, as we have said, difficult to manage successfully; and the resulting pictures have, though more minutely defined, and free from many defects inherent to copies through paper, the same disadvantages as those of the Daguerreotype, viz. the positions are reversed, and the copies cannot be multiplied.

A good negative picture having been obtained and carefully set, copies may be procured on almost any kind of photographic paper, the following are the formulas, for making the papers commonly used

* The process of Mr. Bousignes for taking positive pictures by a sort of Daguerreotype process on paper is given in the appendix.

for the purpose. The energiatype paper, which is also very suitable, is described further on.

1. Mr. Fox Talbot's Photographic Paper.—Take a sheet of good paper, and having dipped it for a minute or so in a solution of common salt, one part of saturated solution to eight parts of water, dry it first in blotting-paper, and then spontaneously. Wash one of the sides, previously marked, with a solution of nitrate of silver—eighty grains to one ounce of distilled water. Allow it to dry, and it is ready for use.

An improved paper of this description may be made by using the following proportions:—25 grs. salt to 1 oz. of water, and 100 grs. nitrate silver to 1 oz. water. Wash the paper with the first solution by a sponge brush, and when dry lay on the silver solution with a large camel's hair pencil. The salt may be replaced by 20 grains muriate ammonia, or by from five to 25 grains muriate baryta. The different substances and different strengths of the solution will beautifully vary the tint of the picture produced.

Mr. Cundell's Paper.—To a solution of one drachm of nitrate silver, in twelve drachms of water, add strong ammonia, till the precipitate which falls is just re-dissolved. Wash the marked side of the paper over with this solution, then dip it in water containing forty grains common salt to the pint; apply the nitrate of silver solution as before, and dry carefully in the dark. It is better to leave a little oxide of silver in the ammoniacal solution rather than to add too much ammonia.

3. Mr. Cooper's Paper.— Soak the paper for a few minutes in a boiling solution of chlorate of potash, (the strength is immaterial;) dry it, and wash it on one side with a solution of nitrate of silver, sixty grains to the ounce of distilled water. This paper is not very sensitive, but the image can be fixed by washing only.

4. M. Daguerre's Paper.—Immerse the paper in hydrochloric (muriatic) ether, which has become acid from keeping; the paper is then carefully and completely dried. It is then dipped into a solution of nitrate of silver, and dried without artificial heat in a perfectly dark room. This paper is very sensitive when quite new, but gradually loses its impressionability.

5. Bromide Paper.— Dissolve 100 grains bromide potassium in one ounce distilled water, and soak the paper in this solution. Take off the superfluous moisture, and when nearly dry brush it over on one side only with a solution of 100 grains nitrate of silver to one ounce of

water. This paper is readily prepared, and tolerably sensitive. If required to be very sensitive, it should be brushed over a second time with the nitrate of silver.

These papers really vary very little from each other, and we can recommend Nos. 1, 2, and 5. The same general rules must be observed in the preparation of each. They must all be dried in the dark after the nitrate of silver has been used. If the paper is brushed over, the brush must be large and broad, so that the whole oft he sheet may be wetted in two or three sweeps, otherwise marks will appear in the paper corresponding to the lines made by the brush. If blotting paper is required, it must be frequently changed, and never used for two different preparations.

Considerable objection is made to the red colour of the positive pictures, obtained in the papers made as directed above. It may be obviated by the following process: dissolve 60 grains of nitrate silver in some distilled water, and add ammonia* *until* the whole of the oxide of silver is precipitated, avoiding the least excess, cleanse the solution containing nitrate of ammonia, and wash the precipitate with distilled water several times. Whilst still moist, add ammonia until the whole is dissolved, and then add distilled water, till an ounce of fluid is obtained This solution will give good blacks on paper first prepared with the chloride of sodium. The quantity of this salt also affects the color, too much giving disagreeable light slate color, and too little a very red beech color. Several methods for obtaining good positive pictures of a pleasing tone, will be found in the appendix.

A sheet of either of the above papers may be taken and laid with the marked side upward, on a piece of board covered with flannel: on this paper must be laid the negative picture with its face downwards, and over both a piece of plate glass, the glass and board being tightly pressed together by screws or weights. The frame described, page 5, is a most convenient apparatus for this purpose. It must now be exposed to light, in about ten or fifteen minutes of bright sunshine, or in several hours of common daylight; a beautiful positive picture is produced, is which the lights and shadows are corrected. These pictures have a fine effect, though they lose somewhat of their sharpness in passing through the copy. They may be set with hyposulphate of soda, as directed for

* Mr. Barber suggests the use of a solution of caustic potash to precipitate the oxide of silver; in this way the whole of the oxide is precipitated, whereas by using ammonia some of it is dissolved by the ammonia.

the *negative* pictures. If the negatives are clear, and the shadows dark, a great many copies may be obtained from them.

We may mention here, that copies of PRINTS, FEATHERS, LACE, etc., are obtained in the same manner as the positive pictures just described; and where it is necessary to reverse them afterwards, as in the case of prints, the process must be gone through twice; that is, a strong negative picture must be first obtained, and then positive copies must be got by printing from it. Beautifully accurate copies of a vast variety of objects may be procured in this way.

Some observations on this subject, which will be found under the head of ENERGIATYPE, will perhaps assist the operator.

Both negatives and positives are much improved by placing them under a sheet of highly glazed paper, and then polishing with a steel burnisher; or the positives may be coated with gelatine, by the following process, which brings out the details with considerable force and effect:—A large sheet of flattened glass framed, something like a slate, with wood, smooth and close, is first cleaned with common soda and water, not too strong, dried, and then sponged over with bullock's gall, full strength; when dry, the following solution may be poured upon it, pure gelatine, about 2 ounces, dissolved in a pint of water 126° Farenheit, this proportion will vary according to quality of the gelatine; after allowing the solution to flow over the whole of the glass, and the excess drained off at the corners, place it on a levelling stand for about twelve minutes, until nearly dry or sticky, then place the positive picture, the face side of which has been damped upon it, and rub it well down so that it may be in perfect contact with the gelatine, then put it aside for about eight hours to dry. The edges may now be cut round with a penknife, and the proofs will split away from the glass and are completed.

CATALISSISOTYPE.

This process was introduced by Dr. Thomas Woods, of Ireland, and has been practised with some success. It is desirable to use unglazed copy paper for this process, or if highly glazed writing paper is used, it should be steeped in water to which hydrochloric acid has been added and dried with blotting paper; two to three drops to three ounces water is sufficient, and this makes the paper imbibe the solutions equally. It is then brushed over with a solution consisting of syrup of iodoret of iron and distilled water each two drachms, tincture of iodine ten to twelve

drops. When this has remained on the paper for a few minntes, so as to be imbibed, dry it lightly with bibulous paper,* and then, in a dark room, wash it over evenly by a camel's-hair pencil with a solution of nitrate silver, sixty grains in an ounce of distilled water. The colour should now be of of a canary yellow; it is ready for the camera, and should be used as soon as possible. The time of exposure varies from two to thirty minutes. When the paper is removed from the camera no picture is visible but when left in the dark a negative picture is gradually developed until it attains a great perfection. The bringing out may be hastened by the use of the Photographic Etna, described page 9. The picture is fixed by washing in water, then soaking for a few minutes in a solution of iodide potassium five grains to the ounce, and finally washing again in water.

"If," says Dr. Woods, "the acid solution," used to prepare glazed paper "be to strong, it produces the very effect it was intended to overcome; that is, it produces yellow patches, and the picture itself is of a light brick colour on a yellow ground. When the tincture of iodine is in excess, partly the same results occur, shewing that the oxide of silver which is thrown down in both cases is re-dissolved by the excess of acid and iodine, and their quantities should be diminished. On the contrary, if the silver solution be too strong, the oxide is deposited in the dark, or by an exceedingly weak light, and in this case blackens the yellow parts of the picture, which destroys it. When this takes place, the silver solution should be weakened. If it be too weak, the paper remains yellow after exposure to light. If the ioduret of iron be used in too great a quantity, the picture is dotted over with black spots which afterwards change to white." Ioduret of iron dissolved in gum water is used in preference by some operators.

The following formula has been given for preparing the syrup of ioduret of iron :—Take of dry iodine 200 grains, fine iron wire, recently cleaned, 100 grains; white sugar in powder 4½ ounces; distilled water 6 ounces. Boil the iodine iron and water together in a glass mattrass, at first gently, to avoid the expulsion of iodine vapours; afterwards briskly, until about two fluid ounces of liquid remain. Filter this quickly, while hot, into a flask containing the sugar; dissolve the sugar

* Mr. Johnstone, who has tried this process with some success, recommends that the bibulous paper should not be used here.

with a gentle heat, and add, if necessary, distilled water to make up six fluid ounces.*

ENERGIATYPE.

The process which Mr. Hunt has designated the Energiatype, is one of the simplest and most convenient modes of obtaining photographic pictures; and the public are much indebted to this gentleman for the prompt and handsome manner in which he communicated his discovery through the pages of the 'Athenæum.'

"While pursuing," he says, "some investigations, with a view to determine the influence of the solar rays upon precipitation, I have been led to the discovery of a new photographic agent, which can be employed in the preparation of paper, with a facility which no other sensitive process possesses. Being desirous of affording all the information I possibly can to those who are anxious to avail themselves of the advantages offered by photography, I solicit a little space in your columns for the purpose of publishing the particulars of this new process. All the photographic processes with which we are at present acquainted, sufficiently sensitive for the fixation of the images of the camera obscura, require the most careful and precise manipulation; consequently, those who are not accustomed to the niceties of experimental pursuits, are frequently annoyed by failures. The following statements will at once shew the exceeding simplicity of the new discovery,"

Here follows, in the original letter, the description of the process as then employed. We shall, however, introduce it to the amateur with such modifications as the experience of Mr. Hunt himself, and other gentlemen who have adopted the method, have suggested to us.

Preparations of the Paper.—Good letter paper, Whatman's or Moinier's pure white is best, is first washed over with the following solution, viz., five grains succinic acid, dissolved in one fluid ounce water, to which is added about five grains common salt, and half a drachm mucilage gum arabic. When dry, the paper is drawn over the surface of a solution of sixty grains of nitrate silver in one ounce of distilled water. Allowed to dry in the dark the paper is now fit for use, is of a pure white, retains its colour, and may be preserved for a considerable time in a portfolio, until wanted for use.

* Correspondent of "The Magazine of Science."

The preparation of this paper is by no means difficult, but requires much care and attention. The solutions must be applied very equally over the paper, which should be immediately hung upon a frame or clothes' horse to dry. Extreme care must be taken that the paper be not exposed to light, after the nitrate of silver solution has been applied, until required for use. Many of the disappointments experienced by the experimenters on the Energiatype are occasioned by a neglect of this precaution; as, although no apparent effect may have been produced by the exposure, the clearness of the subsequent picture will be seriously injured. The succinic acid must also be very pure. It may be useful to mention, that this paper when discolored may be restored by placing it in chlorine gas.

We shall now briefly describe the method of applying the Energiatype to the different purposes for which it is best adapted, premising that the varying circumstances of time, place, and light, will render necessary such modifications of the following directions as the experience of the operator may suggest. As a general rule, an open situation, sunshine, and, if possible, the morning sun, should be preferred, as the image is sharper, and the colour produced more intense and less affected by the subsequent fixing process.

For Camera pictures, the time necessary for exposure is from two to five minutes, according to the light. To bring out the picture wash the paper rapidly and carefully over with the following solution:—

Protosulphate Iron 8 grains.
Distilled Water 1 oz.

If the paper is of a porous substance add two drachms of mucilage of gum arabic to the solution. A sponge or camel hair brush should be used to brush or stir up the solution on the paper, at any part on which black spots appear, while the picture is developing. A few drops of acetic acid added to the solution will improve the tone of the picture. When the picture is sufficiently brought out, it should be washed *directly* in clean water, and then set with a solution of hyposulphite of soda, as in the calotype.

For a building, an exposure of half a minute in strong sunshine is usually sufficient; for a portrait, which can only be taken in the shade two or three minutes is required. Directions for placing the camera, sitter, etc., etc., will be found under the Calotype process, at page 13.

Exact copies of prints, feathers, leaves, etc., may be taken, by

exposing them to the light in the copying-frame, described p. 5, until the margin of the prepared paper, which should be left uncoverd, begins to turn very slightly. If the object to be copied be thick, the paper must be allowed to assume a darker tint, or the light will not have penetrated it.

It has been found by experiment, that the sulphate of iron has the property of developing the latent images on papers prepared with other salts of silver, and that by using the acetate bromide, benzoate, etc., the most varied and beautiful effects are elicited.

The calotype picture may, it is said, be developed in this way after an exposure of one or two seconds only.

CHRYSOTYPE.

Sir John Herschel, whose various experiments have done so much for the art of Photography, is the discoverer of this process, and that of the cyanotype, of which we shall next speak. They are both founded upon the use of the salts of iron as photographic agents. The chrysotype process was communicated to the Royal Society in June, 1843, and is as follows:—

Paper is washed over with a moderately concentrated solution of ammonia-citrate of iron, and dried,—the strength of the solution being such as to dry into a good yellow colour, and not at all brown. In this state it is ready to receive a photographic image, which may be impressed on it, either from nature in the camera obscura, or from an engraving in a frame in sunshine. The image so impressed, however, is faint, and sometimes hardly perceptible. The moment it is removed from the camera, it must be washed over with a neutral solution of gold, of such strength as to have the colour of sherry wine. Instantly the picture appears; not, indeed, at once with its full intensity, but darkening rapidly up to a certain point. At this point nothing can surpass the sharpness and perfection of detail of the resulting photograph. The picture is now to be rinsed in spring water, which must be three times renewed. It is then blotted and dried, after which it is to be washed on both sides with a somewhat weak solution of hydriodate of potash. After being again rinsed and dried, it is now perfectly fixed. If the nitrate of silver be used instead of the solution of gold, the picture is brought out but more slowly and with much less beauty.

CYANOTYPE OR FERROTYPE.

This name has been given, by Sir John Herschel, to several processes in which cyanogen is used in combination with iron. The term ferrotype, which is sometimes applied to them, may with more propriety designate the whole of those photographic processes, a numerous class in which iron may be employed as the developing agent.

First Process.—The paper is washed over, as in the chrysotype, with a solution of ammonia citrate of iron. It is now exposed to light and a latent picture impressed upon it. If the paper has sensibly darkened, the picture will appear negative. It is now brushed over very sparingly and equally with a solution of the ferro-cyanate potash, in which is dissolved a little gum arabic. The negative picture quickly vanishes, and is more slowly replaced by a positive one of a violet blue colour, on a greenish yellow ground. If when dry the details are not sufficiently distinct, a second wash will generally bring out the picture, such should be beautiful and sharp.

Second Process.—A paper is prepared with a mixture of equal proportions of ammonia-citrate iron and ferro-sesquicyanate of potash. When a picture has been impressed, it is thrown into water and dried, and a negative picture results. If this picture is washed with a solution of the proto-nitrate mercury, it is readily discharged, but is susceptible of restoration by thoroughly washing out the mercurial salt, and drying the paper. A smooth iron, rather hot, but not sufficiently so to scorch the paper, is now passed over it, and the obliterated picture immediately re-appears, but of a brown tint. These photographs gradually fade and disappear, but may be again restored by the application of heat.

Third Process.—One part by weight of ammonia-citrate of iron is dissolved in eleven parts of water, and this is mixed with an equal quantity of saturated cold solution of bichloride mercury. Before a precipitate has had time to form, the solution is brushed over paper, which should have a yellowish rather than a blueish cast, and dried. This paper keeps well, and when used is exposed to light, until a faint but perfectly visible picture is impressed. It is then brushed over as rapidly as possible with a saturated solution of prussiate of potash, diluted with three times its bulk of gum water, so strong as just to flow freely without adhesion to the lip of the vessel. The wash must be

spread with one application, evenly and very quickly, over every part of the paper. It is fixed by drying. Beautiful positive pictures are thus produced, which will bear immediate exposure tolerably well, but which after a few days will bear strong sunshine uninjured. If the impression be overdone, the darker shades will disappear: if too little, the whole runs into blot. The exact time of exposure can only be learnt by practice.

There are several other varieties of these processes, which are not sufficiently important to be included here: the formula may be seen by reference to Sir John Herschel's Papers in the 'Philosophical Transactions.' The following process, communicated by him to the British Association in 1843, is, however, so curious, that we are induced to insert it here. If nitrate of silver, specific gravity 1.200, be added to ferro-tartaric acid, specific gravity 1.023, a precipitate falls, which is in a great measure re-dissolved by a gentle heat, leaving a black sediment which, being cleared by subsidence, a liquid of pale yellow colour is obtained, in which a further addition of the nitrate causes no turbidness; when the total quantity of the nitrated solution added, amounts to about half the bulk of the ferro-tartaric acid, it is enough.

The liquid so prepared does not alter by keeping in the dark. Spread on paper and exposed wet to sunshine (partly shaded) for a few seconds, no impression seems to have been made; but, by degrees, although withdrawn from the light, it develops itself spontaneously, and at length becomes very intense. But if the paper be thoroughly dried in the dark, (in which state it is of a very pale greenish yellow colour,) it possesses the singular property of receiving a dormant or invisible picture; to to produce which (if it be, for instance, an engraving that is to be copied) from thirty seconds to a minute's exposure in the sunshine is requisite. It should not be continued too long, as not only is the ultimate effect less striking, but a picture begins to be *visibly* produced, which darken spontaneonsly after it is withdrawn. But if the exposure be discontinued before this effect comes on, an invisible impression is the result, to develope which all that is necesary is to breathe upon it, when it immediately appears, and very speedily acquires an extraordinary intensity and sharpness, as if by magic. Instead of the breath, it may be subjected to the regulated action of aqueous vapour, by laying it in a blotting paper book, of which some of the outer leaves on both sides have been damped or by holding it over warm water

CHROMOTYPE.

M. Pontin was the first to point out the photographic properties of bichromatic of potash. His process for preparing paper is as follows:—immerse a well-sized paper in a saturated solution of bichromatic potash, and dry by the fire. It is of a fine yellow colour, and keeps well in the dark. When exposed to the rays of the sun, it becomes of a light brown; and if an engraving has been placed upon it, the resulting picture is negative. It is fixed by soaking in water. Mr. E. Becruerel improved upon this process by applying evenly over the paper a sizing of starch, and then steeping it in the bichromate solution as before. The picture having been taken, and the paper washed and dried, it is immersed in a weak alcoholic solution of iodine, in which it remains some time, and is then rinsed and carefully dried between blotting paper, without much heat. When wet, the shades of the picture are of a fine blue; but when dry, of a deep violet. If the picture, while wet, is covered with a coating of gum, the colour is better preserved, and is more beautiful when dry.

Mr. Hunt announced the process, which is termed the chromotype, at the meeting of the British Association in 1843. It is not sufficiently sensitive for the camera, but is valuable for copying engravings, etc. Good writing paper is washed over with sulphate of copper, in solution, about one drachm to an ounce of water; when dry, it is again washed with a strong, but not saturated, solution of the bichromate of potash, and again dried. The paper may be preserved in this state for a considerable time. When exposed to sunshine, it changes to a dull brown, and if checked here, a negative picture is produced; but if the action of light is continued, the browning gives way, and the picture becomes positive,—yellow on a white ground. From five to twenty minutes is usually required to produce the effect. In either case, if the picture be washed over with a solution of nitrate of silver, a very beautiful positive picture results. To fix the picture, wash it immediately in pure water, and dry it. If the water contains any muriates, the picture suffers, and long soaking entirely destroys it. When a few grains of common salt are added to the water, a curious effect is produced: the picture is apparently rapidly destroyed, but may be restored by an exposure to the sun of from ten minutes to a quarter of an hour, and is now of a lilac colour,—the shades depending on the quantity of salt used. No fresh process is required to fix it.

A beautiful variety of the chromotype is thus described by Mr. Hunt. "A neutral solution of the chloride of gold is mixed with an equal quantity of the bichromate of potash. Paper is washed with this solution, and dried near the fire. On exposing this paper to light, it speedily changes, first to a deep brown, and ultimately to a blueish black. If an engraving is superposed, we have a negative copy, blue or brown, upon a yellow ground. If this photograph is placed in clean water, and allowed to remain in it for some hours, very singular changes take place. The yellow salt is all dissolved out, and those parts of the paper left beautifully white. All the dark portions of the paper become more decided in their character, and accordingly as the solarization has been prolonged or otherwise, or the light has been more or less intense, we have either *crimson, blue, brown, or deep black photographs of a most beautiful character.*"*

AMPHITYPE.

This is another of the interesting and valuable discoveries of Sir John Herschel. It was given to the public at the last meeting of the British Association, and is described by him as follows :—

Paper, proper for producing an amphitype picture, may be prepared, either with the ferro-tartrate or the ferro-citrate of the protoxide or the peroxide of mercury, or of the protoxide of lead; by using creams of these salts, or by successive applications of the nitrates of the respective oxides, singly or in mixture, to the paper, alternating with solutions of the ammonia-tartrate or ammonia-citrate of iron,† the latter solutions being last applied, and in more or less excess. I purposely avoid stating proportions, as I have not yet been able to fix upon any which certainly succeed. Paper so prepared and dried takes a negative picture, in a time varying from half an hour to five or six hours, according to the intensity of light; and the impression produced varies in apparent force from a faint and hardly perceptible picture, to one of the highest conceivable fulness and richness, both of tint and detail, the colour in this case being a superb velvety brown. This extreme richness of effect

* Researches on Light, by Robert Hunt, 1844.

† So commonly called, and sold as such; but as I am disposed to regard their composition, their chemical names would be ferro-tartrate and ferro-citrate of ammonia.

is not produced except lead be present, either in the ingredients used, or *in the paper itself*. It is not, as I originally supposed, due to the presence of free tartaric acid. The pictures in this state are not permanent They fade in the dark, though with very different degrees of rapidity, some (especially if free tartaric or citric acid be present) in a few days. while others remain some weeks unimpaired, and require whole years for their total obliteration. But though entirely faded out in appearance, the picture is only rendered dormant, and may be restored, changing its character from negative to positive, and its colour from brown to black (in the shadows) by the following process:—A bath being prepared by pouring a small quantity of solution of pernitrate of mercury into a large quantity of water, and letting the sub-nitrated precipitate subside; the picture must be immersed in it, (carefully and repeatedly clearing off all air bubbles,) and allowed to remain till the picture (if any where visible) is entirely destroyed, or if faded, till it is judged sufficient from previous experience—a term which is often marked by the appearance of a feeble positive picture, of a bright yellow hue, on the pale yellow ground of the paper. A long time (several weeks) is often required for this, but heat accelerates the action, and it is often complete in a few hours. In this state the picture is to be very thoroughly rinsed and soaked in pure warm water, and then dried. It is then to be well ironed with a smooth iron, heated so as barely not to injure the paper; placing it, for better security against scorching, between smooth clean papers. If then the process has been successful, a perfectly black positive picture is at once developed. At first it most commonly happens that the whole picture is sooty or dingy to such a degree that it is condemned as spoiled; but on keeping it between the leaves of a book, especially in a moist atmosphere, by extremely slow degrees this dinginess disappears, and the picture disengages itself with continually increasing sharpness and clearness, and acquires the exact effect of a copper-plate engraving on a paper more or less tinted with pale yellow. I ought to observe that the best and most uniform specimens which I have procured, have been on paper previously washed with certain preparations of uric acid, which is a very remarkable and powerful photographic element. The intensity of the original negative picture is no criterion of what may be expected in the positive. It is from the production, by one and the same action of the light, of either a positive or a negative picture, according to the subsequent manipulations,

that I have designated the process thus generally sketched out, by the term *amphitype*,—a name suggested by Mr. Talbot, to whom I communicated this singular result; and to this process, or class of processes, (which I cannot doubt when pursued will lead to some very beautiful results,) I propose to restrict the name in question, though it applies even more appropriately to the following exceedingly curious and remarkable one in which silver is concerned. At the last meeting I announced a mode of producing, by means of a solution of silver, in conjunction with ferro-tartaric acid, a dormant picture brought out into a forcible negative impression by the breath or moist air. The solution then described, and which had, at that time, been prepared some weeks, I may here incidently remark, has retained its limpidity and photographic properties quite unimpaired during the whole year since elapsed, and is now as sensitive as ever,—a property of no small value. Now, when a picture (for example, an impression from an engraving) is taken on paper washed with this solution, it shows no sign of a picture on its back, whether that on its face be developed or not; but if, while the actinic influence is still fresh upon the face, *(i. e.* as soon as it is removed from the light,) *the back* be exposed for a very few seconds to the sunshine and then removed to a gloomy place, a *positive picture, the exact complement of the negative one on the other side,* though wanting of course in sharpness if the paper be thick, *slowly and gradually makes its appearance* there, and in half an hour or an hour acquires a considerable intensity. I ought to mention that the "Ferro-tartaric" acid in question is prepared by precipitating the ferro-tartrate of ammonia (ammonia-tartrate of iron) by acetate of lead, and decomposing the precipitate by dilute sulphuric acid.

P. S. When lead is used in the preparation of Amphitype paper, the part on which the light has acted are found to be in a very high degree *rendered waterproof.*

ANTHOTYPE.

The influence of light upon the growth and germination of plants is very curious and interesting. The facts connected with this subject have been investigated by Mr. Chevrieul, Mr. Hunt, and Sir John Herschel. To the latter gentleman we are indebted for the inquiries which have led to the publication of the Anthotype process. He found that the expressed juices, and alcoholic or watery infusions of certain

flowers, more particularly the papaver rhœas, the corchorus japonica, the violet, rose, ten weeks' stock, etc., etc., when spread on paper, were very sensitive to light. To preserve this colouring matter, the petals of fresh and well-selected flowers are bruised to a pulp in a marble mortar, either alone or with the addition of a small quantity of alcohol,—the juice is expressed by squeezing the pulp through a piece of fine linen. The paper is prepared in the following manner:—"The paper should be moistened on the back by sponging and blotting off. It should then be pinned on a board, the moist side downwards, so that two of its edges (suppose the right hand and lower one) shall project a little beyond those of the board. The board being then inclined twenty or thirty degrees to the horizon, the alcoholic tincture (mixed with a very little water, if the petals themselves be not very juicy) is to be applied with a brush, in strokes from left to right, taking care *not to go* over the edges which rest on the board, but to pass clearly over those that project; and observing also to carry the tint from below upwards by quick sweeping strokes, leaving no dry spaces between them, but keeping up a continuity of wet spaces. When all is wet, cross them by another set of strokes from above downwards, so managing the brush as to leave no floating liquid on the paper. It must then be dried as quickly as possible over a stove, or in a current of warm air, avoiding, however, such heat as may injure the tint." If alcohol has not been added, the extract must be applied to the paper immediately. Most of the papers so prepared require an exposure of many days, from twenty to thirty, to produce a decided effect, and the pictures obtained are not always permanent. This will of course preclude their being of practical utility; but the changes produced are so remarkable, that we could not, with propriety, omit mentioning them. A full account of Sir John Herschel's experiments will be found in his Memoir, or, "The Action of the Rays of the Solar Spectrum on Vegetable Colours," etc., published in the second part of the Philosophical Transactions for 1842.

Similar effects are produced by light in the gums, resins, and residua of essential oils, when thin films are spread upon paper or on metal plates. A paper prepared with an alcoholic solution of guaicum, and placed in an aqueous solution of chlorine, acquires a beautiful blue colour; it is very sensitive, and may be used for copying engravings, the resulting picture penetrating the paper, and appearing on the back with almost the same intensity as on the face. The images, however, speedily fade.

This process which is characterised by its easy preparation, and the sensibility of the papers when carefully prepared, consists in the formation of a salt of silver, which must be considered as a fluo-bromide of silver. It is difficult to say, which is the best manner of proceeding; but the difference, as it regards the sensibility of papers is so very trifling, that it is not of much importance. The paper is to be washed first with the bromide of potassium, and then with the fluate of Soda; or, which will be found perhaps the best plan, the two salts may be united. The strength of the solutions should be as follows:—

Bromide of potassium....	20 grains.
Distilled water.....	1 fluid ounce.
Fluate of soda.....	5 grains.
Distilled water.....	1 fluid ounce.

Mix a small quantity of these solutions when the papers are to be prepared, and wash the paper once over with the mixture, and when dry, apply nitrate of silver, in solution, 60 grains to an ounce of water. These papers keep for some weeks without injury, and they become impressed with images in half a minute in the camera. This impression is not sufficiently strong to serve, in the state in which it is taken from the camera, for producing positive pictures, but it may be rendered so by a secondary process.

The photograph is first soaked in water for a few minutes; it is then placed upon a slab of porcelain or glass, and a weak solution of the protosulphate of iron applied, which very quickly darkens, all the parts on which the light has acted, to a dark brown, and every object is brought out with great clearness. When the best effect is produced, the process must be stopped. All that is necessary is to soak the paper in water, and then fix the drawing with hyposulphate of soda.

Fluoride of soda or potassium is now much used to accelerate the calotype process.

GUADINOTYPE.

Mr. Gaudin has proposed a process analogous to that of the catalissotype. The paper having been exposed for a minute in the vapour of hydro-chloric acid, is brushed over with a nearly saturated solution of nitrate silver and dried. It is placed in the camera in the dark. On removing it, no trace of a picture is visible, but when wetted with a

nearly saturated solution of sulphate of iron slightly acidified by the addition of a few drops of sulphuric acid; the picture immediately developes itself. It is fixed by washing in distilled water, repeating the washing in distilled water, to which has been added 10 per cent. of caustic ammonia. The time of exposure is about the same as the calotype, and the paper as first prepared makes a good postive paper.

COLORING PAPER PHOTOGRAPHS.

A very good effect may be produced by tinting the sun pictures, but the artist must select his colors with judgment, so that the pigment employed shall not, while in a moistened state, act upon the salts in the paper, or be acted upon by them. By the use of the colored French chalks or sepia, the appearance of a photograph is much improved, or by stipling on dry colours in the same manner as directed for Daguerreotype pictures in No. 2 Manual. Most of the portraits taken by Mr. Talbot's license are touched up with a body colour which much improves bad photographs.

THERMOGRAPHY.

If a coin be laid on a polished silver plate, and the plate be then gently heated and allowed to cool, an impression will be formed of the coin on its surface, which will become visible on breathing over the plate. The figure will remain for several days, only requiring to be breathed on to become visible, and if the plate be exposed to the vapour of mercury, the impression becomes fixed.

Almost any substance laid upon a polished surface of glass, slightly warmed, will produce an impression when breathed on; the definition of which varies with the substance employed. For instance, a coin allowed to remain on a looking-glass a few minutes, and breathed over three or four times, will, on the coin being removed, be rendered visible for weeks by merely breathing on the surface of the glass, provided it be not rubbed during that time, which would destroy the impression. The same result is produced by exposure to the sun-light for several hours.

For much curious information on this subject we must refer our readers to Mr. Huut's Valuable Researches on Light.

We have endeavoured in the preceding pages to retain all that was really valuable in the older editions, with such alterations and corrections as may tend to the simplification or perfection of the processes specified. We cannot in conclusion, too much encourage the amateur to study carefully the various rules laid down, not adopting every novelty he meets with, but steadily endeavouring to make himself master of some one. His ultimate success is certain, and he may then, with sure confidence, make such modifications in his formula or manner of working as the experience of others may point out as improvements. The art of Photography is steadily advancing and is, we believe, destined to become invaluable to mankind.

The death of M. Daguerre has saddened but not discouraged his numerous followers who are determined to make his beautiful invention a fitting monument to his memory. The disciples of Talbot in England are only less zealous because of the restrictions which, unfortunately, surround the practice of Heliography on paper, those of France, unfettered as they are, already placing it in a position to rival most completely its sister art. We regret to find that another process, said to be discovered by Mr. Talbot, by which instantaneous pictures are impressed upon prepared surfaces is about to be patented. It is a great pity that the Royal Society, or some other scientific body, will not undertake to determine priority of invention in such matters, for this is probably the sole motive for patenting processes which can only come into general use, and therefore profitable as commercial speculations, when open to the free use of all. A small sum appropriated by Parliament as a reward for inventions of this character, would save the English from the disgrace of proving themselves to be, what their neighbours have thunderously reported them, a NATION of SHOPKEEPERS.

ERRATA.

In page 41, line 28, for *thunderously* read *slanderously*.

In page 44, line 8, for *Athaneum* read *Atheneum*.

APPENDIX.

NEW METHOD OF PREPARING A PAPER, ON WHICH POSITIVE PICTURES MAY BE OBTAINED.—BY M. BOUSIGNES.

ANY paper of uniform quality and lightly sized, free from all metallic spots, &c., may be used. Three pieces of this paper, the size required, are to be plunged into distilled water, and stretched upon the glass or slate ordinarily used, taking care to press the papers close together by a fine linen rag. Place upon the other two that which seems best adapted to receive the image, the others are only useful to keep up moisture and adhesion. When the moisture shall have disappeared from the surface, let fall upon it three or four drops of a neutral solution of nitrate of silver, which must be rapidly spread over by means of a brush. The traces of this solution will quickly disappear, leaving only a sort of vapour on the paper. In this state the paper is treated as a daguerreotype plate and exposed to the vapours of iodide and bromide of lime, to the first for fifteen seconds, to the second thirty-five seconds, and again over the iodide for ten seconds. The glass or slate and paper is then placed in the frame of the camera, and the light acts with almost the same rapidity as in the daguerreotype; the image is developed by the vapour of mercury and is positive.

The following precautions, since laid down by M. B. are necessary to secure success. The silver may contain about five parts nitrate to thirty parts water, a little stronger or weaker,—it must be kept from the influence of light. If the surface of the paper when iodized presents violet or white spots, the solution of silver has not been equally spread over the paper, or has moistened it too much. If a negative proof be desired, the time of exposure may vary from 20 seconds to 30 or 50, or even 100 without failure; but to obtain the positive is more difficult. If the piece of paper become generally black after exposure to mercury, it is a certain proof that the exposure has not been long enough, if on the contrary the paper is entirely white, it has been too long. Between these two is the point when good proofs, negative and positive, are to be met with.

CALOTYPE PROCESS WITH AMMONIA BY M. AUBREE.

Take of distilled water, 250 parts; iodide potassium 12 parts; fluoride potassium 1 part; liquid ammonia, 4 parts. Put the iodide and fluoride into the distilled water, when the salts are dissolved add to it the ammonia, and pass the whole through a paper filter. The object of the ammonia is to quicken the operation, and, at the same time, to neutralize a certain quantity of free fluoric acid; half an hour after this preparation, pour the liquid into a trough, a little larger than the paper you wish to prepare, immerse your paper and leave it for one or two minutes in the solution: take care to turn it in order to prevent air bubbles, and hang it on a line to dry. When you have sufficient paper prepared, and it is all quite dry, enclose it in a portfolio carefully preserved from damp. For the second preparation, put into a phial 250 parts water, then add 30 parts nitrate silver, and when this is dissolved, 45 parts acetic acid. If this preparation becomes milky it must be filtered. Apply the paper already prepared on one side only to the aceto-nitrate of silver solution, and by the light of a taper take care to raise the paper immediately, to be assured that there are no air bubbles upon it, or there will be spots upon the negative. When the sheet of paper shall have become white all over, leave it still twelve to twenty seconds on the bath and then removing it, lay it upon the glass of your camera which should already have been well washed and have a piece of tough paper moistened and stretched upon it. The proper side of the paper being in front, pass a cylinder of glass over your paper to unite it to the first piece and to chase the air bubbles. The operation is intended also to prevent any excess of aceto-nitrate which would run down the paper and displace the lines of the picture.

These conditions fulfilled, put the glass into the frame and expose it from twenty to sixty seconds according to the lens and the light. If extreme quickness is desired place the glass for a short time in hot water, and do the same with the first paper to be spread upon it. For the third operation put into a phial 300 parts distilled water and add three parts gallic acid; this solution should be made 24 hours before using it filtering it to separate any excess of gallic acid.

Withdrawing the glass from the frame, place it upon a level support, and pass over the surface of the paper the iodide of gallic acid by means of a flat brush of camel's hair, the image will immediately begin to appear. When you think it is sufficiently come, when you see it perfectly designed in all parts, well modelled, the lines well defined and the half tints well preserved, place it in a trough filled with rain water. The image may be developed more quickly by the vapour of boiling water. After a few minutes withdraw your negative from the water bath and plunge it for ten minutes or a quarter of an hour in a solution composed of distilled water, 500 parts, bromide potassium, sixteen parts, then wash it again in rain water and dry it between blotting paper.

ANOTHER PROCESS WITH AMMONIA, BY HUMBERT DE MOLARD ET AUBREE

Immerse completely, for about a minute, one side of a sheet of paper in the following solution. Distilled water, 150 parts; iodide ammonia, 10 parts. The colour of this solution will be amber. The paper will become violet if it contain a mixture or acid; in other cases white, which may always be obtained by adding a few drops of liquid ammonia. Leave the paper to dry, and afterwards float it on the following bath:—distilled water, 250 parts; nitrate silver, 16 parts; nitrate zinc 8 parts; acetic acid, 8 parts; leave it until it is well moistened and clear.

This paper being drained is laid on a glass previously covered with two sheets of damp paper, the excess of liquid is removed by means of a glass rod or piece of blotting paper. The time of exposure for views is—in the sun, from 1 to 2 seconds; in the shade, 4 to 5 ditto; for portraits, 15, 20, or 25 ditto; in a room, 50 to 60 ditto.

To bring out the image add six parts liquid acetate ammonia, to 180 parts saturated gallic acid, and let the liquid run over the paper, inclining the glass, without giving it time to settle and spot. Wash well with several waters, and fix as usual with hypo-sulphite soda. Paper bleached with chalk or chlorine will present a marbled appearance.

NOTES OF EXPERIMENTS MADE IN THE YEARS 1844-5, BY MR. JOHNSTONE, OF BIRMINGHAM.

We have been favoured with these observations by our friend, who is known as a most successful amateur, and one who is ever ready to assist others, by making known the results of his constant experiments for the advancement of heliography.

A paper washed with a solution of nitrate of silver was placed under a small print and exposed to sunshine for about a few minutes, and then washed with a weak solution of sulphate iron, which had been made a long time; a negative photograph was slowly developed.

A very good positive paper may be made by washing in one part saturated solution of salt to fifteen parts of water, and then working with the ammonia nitrate of silver.

Skimmed milk with nitrate of silver will be found to answer well.

Sugar, sulphate of iron, and nitrate of silver gave rather a red tint.

Honey, sulphate of iron, and nitrate of silver, gives a very good paper, the whites being well preserved.

Manna and Lactic acid quickened the action of positive papers.

Muriate of tin combined with silver gave a bluish-toned picture.

A saturated solution of tartrate of soda, one-sixth of a pint; saturated solution of common salt, one part; water, six parts; nitrate of silver, one drachm to the ounce, gave good results with a pinkish hue.

A black tone may be given to negatives by immersing them for a few seconds in water, slightly acidulated with sulphuric acid, after taking them from the hyposulphite bath. They must be well washed afterwards in clear water.

PROCESS WITH PROTO-NITRATE IRON BY MR. ROBERT ELLIS COMMUNICATED TO THE "ATHANEUM."

Mr. Ellis takes iodized paper prepared in the usual manner, selecting those sheets, which are thinnest and closest in texture. The surface of this paper is then washed consecutively with a weak solution of proto-nitrate of iron and of nitrate silver. The proportions need not be exact, but perhaps the best are twenty-five grs. nitrate of silver to the ounce water, and about six grs. nitrate iron in same quantity; on being slightly dried with bibulous paper it is ready for the camera and must be used soon. An exposure of ten or fifteen seconds is generally sufficient; on removal, the sheet is usually white but the outlines soon appear, and in a short time the whole is developed. It is, advisable on the full development of the picture to plunge it into a dish of cold water.

The proto-nitrate of iron is easily made by pouring dilute cold nitric acid over sulphuret of iron, filtering and heating to expel any sulphuretted hydrogen present. The paper does not answer unless used damp and freshly prepared.

MEANS OF COLORING, CHEMICALLY, THE POSITIVE PROOF BY MR. BLANQUART EVRARD.

These colors are obtained by introducing into a bath composed of one part hyposulphite soda, to six parts water: first, a few drops of ammonia, this renders the bath alakine, and produces a reddish sepia tone; second, a few drops of acetic acid which renders the solution acid and passes to a fine black through the violet tints.

A somewhat similar effect is produced by the addition of a little nitric or sulphuric acid but the whites are apt to spot; in that case by adding a very little aceto nitrate of silver the tones are much blackened and the effect is very good. It is for this reason that old hyposulphate solutions impregnated with salts of silver are much preferable for setting pictures than fresh ones. The first effect of old baths is to give firmness to the tints, the after effect is to thin them. If the action be prolonged beyond that limit a yellow tone is produced, as with all acid baths. By the use of several of these baths the proof may be brought to a suitable tone, thus, if it is too deep it may be reduced by exposure to an alkaline bath, if too light, to an acid bath, but the use of them demand some experience, and care must be taken not to pass a proof from an alkaline bath to an acid one, or *vice versa*, without first rendering it neuter by washing and then plunging it into a neutral solution of hyposulphite soda for a minute or two. By adding to the hyposulphite bath some crystals of acetate of lead you get a reddish violet tone very peculiar. In this case the proof must be placed in the solution of neutral hyposulphite of soda and then passed into the bath just mentioned, avoiding the acid or alkaline baths. Afterwards, a deep violet tone is given by placing the proof in an acid bath, but the peculiar effect of the acetate of zinc is thus lost.

The satisfactory use of these baths depends much on the state of the proof. If that be feeble, the decolorising effect of the baths soon deprives it of all vigour. If, on the contrary, it be very vigorous, the proof will support the bath perfectly and duly improve under it, the whites becoming each moment clearer and clearer. It is therefore necessary when it is proposed to expose a proof to the action of one of these baths that it should be rather over done than not. It must be understood that the proofs are first set in the ordinary hyposulphite bath.